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- (71) Applicant (for all designated States except US): **GEOX S.P.A.** [IT/IT]; Via Feltrina Centro 16, I-31044 Montebelluna (IT).
- (72) Inventors; and
- (75) Inventors/Applicants (for US only): **POLEGATO MORETTI, Mario** [IT/IT]; Via Antonini, 7, I-31035 Crocetta del Montello (IT). **FERRARESE, Antonio** [IT/IT]; Via Rimembranza, 23, IT-37063 ISOLA DELLA SCALA (IT).
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(54) Title: **WATERPROOF AND BREATHABLE SOLE FOR SHOES**

(57) Abstract: Waterproof and breathable sole for shoes, having a structure that comprises: a mid-sole component (10, 110) with a membrane (11, 111) made of a material that is impermeable to water and permeable to water vapor and is connected in spots with a lower protective layer (14, 114) made of a material that is resistant to hydrolysis, water-repellent, breathable and/or perforated; a tread (15, 115) made of perforated elastomer that is joined perimetrically and hermetically to the component (10, 110); said membrane (11, 111) being associated with said protective layer (14, 114) by way of a thermoreactive adhesive (13, 113).

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## WATERPROOF AND BREATHABLE SOLE FOR SHOES

Technical Field

The present invention relates to an improved waterproof and breathable sole for shoes.

5 Background Art

Plastic waterproof and breathable soles for shoes are already known.

One of these soles is disclosed in Italian patent no. 1,282,196 by the same Applicant.

In this case, the sole comprises:

- 10 -- a mid-sole with a membrane made of a material that is impermeable to water and permeable to water vapor, associated with a lower protective layer made of a material that is resistant to hydrolysis, water-repellent, breathable and/or perforated;
- a tread made of perforated elastomer that is joined perimetrically and
- 15 hermetically to the mid-sole.

A waterproof and breathable sole disclosed in WO 98/51177 by the same Applicant is also known; it comprises a preassembled insert in which there is a membrane that is impermeable to water and permeable to water vapor, associated with a lower protective layer made of a material that is

20 resistant to hydrolysis, water-repellent, breathable and/or perforated.

The insert is completed by an element that is overmolded or assembled in place and surrounds the membrane and the protective layer and is joined hermetically to them.

The insert is part of a mid-sole and is joined together with said mid-sole

25 to a tread made of perforated plastic, which is overmolded or assembled in place.

In both cases, the protective layer arranged below the membrane is meant to protect said membrane against piercing due to foreign objects accidentally passing through the holes.

30 The protective layer is normally made of felt and is coupled to the

membrane in a breathable manner (by means of spots of thermoplastic adhesive which has for example a polyurethane base), to allow the passage of the vapor from the inside of the shoe toward the outside through the holes provided in the tread.

- 5 Although the soles described above have been commercially available for years now and are unanimously acknowledged to be capable of ensuring a correct exchange of heat and water vapor between the microclimate inside the shoe and the external microclimate, they have been found to have drawbacks, including in particular the tendency for the membrane to tear  
10 due to the different traction elasticity modulus with respect to the tread, with which it is monolithically assembled peripherally.

The membrane is in fact normally made of expanded polytetrafluoroethylene, which is a scarcely elastic material, while the tread by its very nature and due to its operating requirements must be very elastic  
15 and flexible.

Accordingly, the membrane is unable to absorb the flexural stresses that produce an elastic elongation of the polymer, of which the elastomeric tread is made (PVC, TR, polyurethane, rubber, et cetera), in movements, during use and accordingly tends to tear because its elasticity modulus is exceeded,  
20 and loses its waterproofness.

The protective element below the membrane, which is normally made of polyester felt, has been found unable, on its own, to absorb the tensions induced by the deformations of the sole.

In order to reduce the elongation, the structure disclosed in  
25 WO 02/32246 A1 has been adopted; this patent describes the use of composite materials with a high ultimate tensile strain and low elongation, but the insertion of said materials is expensive and also causes a general stiffening of the shoe.

Furthermore, the problem of the breakage of the membrane is not solved  
30 permanently, because of the reversibility of the phenomenon of

thermoplasticity of the polyurethane adhesive used to laminate the membrane with the felt layer: the melting point of said adhesive (for example 65 °C) is in fact lower than the temperature (for example 180 °C) at which the polymer that constitutes the tread and must form a peripheral seal on the membrane is injected into the mold.

Temperatures higher than the melting point of the polyurethane adhesive can be reached both during the normal production of the shoe and during use of the shoe (for example when walking on hot tarmac during the summer period).

By reaching temperatures higher than the melting point, the thermoplastic adhesive is reactivated and the viscosity is reduced considerably (it is known that viscosity is a function of temperature), allowing complete absorption of said adhesive by the felt.

This means that once the assembly cools, there is no longer enough adhesive to allow adequate coupling of the membrane to the felt layer.

All the stress to which the sole is subjected during use is therefore transmitted to the membrane, which tears due to the problems described above.

This problem is entirely new in soles with respect to other uses for which a membrane that is impermeable to water and permeable to vapor is used.

This performance at high temperatures is in fact not required, for example, for producing laminated fabrics to be used as a lining on an upper, because in such cases temperatures on the order of the temperatures reached in the molding of soles made of polymeric materials are never reached.

In these cases, a maximum temperature of 100 °C can in fact be reached.

#### Disclosure of the Invention

The aim of the present invention is therefore to provide a waterproof and breathable sole for shoes having an improved structure that is capable of eliminating the drawbacks noted above in known types, which lead to the tearing of the waterproof and water vapor-permeable membrane.

Within this aim, an object of the invention is to not reduce in any case the waterproofness and breathability capabilities of the sole.

Another object is to provide a sole that does not entail particular constructive complications with respect to known soles.

5 Another object is to provide a sole whose costs are competitive with respect to the costs of known types.

This aim and these and other objects that will become better apparent hereinafter are achieved by a waterproof and breathable sole for shoes, having a structure that comprises:

- 10 -- a mid-sole with a membrane made of a material that is impermeable to water and permeable to water vapor and is associated in spots with a lower protective layer made of a material that is resistant to hydrolysis, water-repellent, breathable and/or perforated;
- a tread made of perforated elastomer that is joined perimetrically and
- 15 hermetically to the mid-sole;

said structure being characterized in that said membrane is associated with said protective layer by means of a thermoreactive adhesive.

#### Brief description of the drawings

Further characteristics and advantages of the invention will become  
20 better apparent from the detailed description of some embodiments thereof, illustrated by way of non-limitative example in the accompanying drawings, wherein:

Figure 1 is a transverse sectional view of a waterproof and breathable sole for shoes having the structure according to the invention, in a first  
25 embodiment thereof;

Figure 2 is a transverse sectional view of a waterproof and breathable sole for shoes having the structure according to the invention, in a second embodiment thereof.

#### Ways to carrying out the Invention

30 With reference to Figure 1, a waterproof and breathable sole for shoes

has, in a first embodiment, a structure that comprises a mid-sole 10 that is composed of a membrane 11 made of a material that is impermeable to water and permeable to water vapor (normally commercially available and made for example of expanded polytetrafluoroethylene), laminated over a supporting mesh 12 made of synthetic material and associated, by way of spots of adhesive 13, with a lower protective layer 14 made of a material that is resistant to hydrolysis, water-repellent, breathable and/or perforated, preferably a polyester felt.

The structure further comprises a tread 15 made of elastomer, with through holes 16, which is overmolded or assembled in place on the mid-sole 10 and is perimetrically joined hermetically thereto (see the borders 17 that surround its edges in Figure 1).

According to the invention, the structure is characterized in that said membrane 11 is associated with said protective layer 14 by way of a thermoreactive adhesive.

Thermoreactive adhesives are adhesives that are per se known in another technical field; they are in fact used for example to produce barrier fabrics for surgical uses, which are formed by two or more layers of different materials that are laminated together.

Said fabrics in fact require repeated sterilizations in an autoclave at high temperatures in order to allow their reuse, and it is evident that the high temperature reached during the sterilization operation must not cause the separation of the two or more elements that constitute the barrier fabric.

These adhesives, due to the temperature, produce many intermolecular bonds (between molecules), thus forming a three-dimensional structure that is partially rigid and in any case thermally irreversible.

The bonds occur between the NCO and OH groups that are present in the molecular chains that constitute said adhesives.

Thermoreactive adhesives, usable for the purposes of the invention are, for example, thermoplastic polyurethane adhesives which are manufactured

by the company SCHAETTI AG, Switzerland, and marketed under the name PU SCHAETTI FIX 6050.

Practical tests of the use of these thermoreactive adhesives to associate in spots the membrane 11 with the protective layer 14 have shown that their  
5 molecular bonds do not allow melting and absorption at high temperatures of the adhesive by the felt of the protective layer 14, preventing the separation of the membrane 11 and thus allowing the distribution of the stress over a larger cross-section (membrane 11 + felt of the layer 14).

All this avoids the breakage of the membrane 11 due to its elasticity  
10 modulus being exceeded.

With reference now to Figure 2, a waterproof and breathable sole for shoes, in a second embodiment, has a structure that comprises a preassembled insert 110, which corresponds to the mid-sole 10 of the previous embodiment and in which there is a membrane 111 which is made  
15 of a material that is impermeable to water and permeable to water vapor (normally commercially available, for example made of expanded polytetrafluoroethylene), which is laminated over a supporting mesh 112 made of synthetic material and associated by spots of adhesive 113 with a lower protective layer 114 made of a material that is resistant to hydrolysis,  
20 water-repellent, breathable and/or perforated, preferably a polyester felt.

The insert 110 is completed by a perimetric element 117 that is overmolded or assembled in place and surrounds the membrane 111 (with the mesh 112) and the protective layer 114 and is joined hermetically to them.

25 The insert 110 is joined to a tread 115 made of elastomer, with through holes 116, that is overmolded or assembled in place thereon.

In this case also, the structure is characterized in that said membrane 111 is associated with said protective layer 114 by way of a thermoreactive adhesive 113.

30 The method for obtaining the described improved shoe sole is based on

the steps for assembling the sole parts as discussed in relation with the preferred embodiments of the invention.

In practice it has been found that the intended aim and objects of the present invention have been achieved.

5       A waterproof and breathable sole for shoes having an improved structure has in fact been devised which eliminates the drawbacks suffered by known types which lead to the tearing of the waterproof and vapor-permeable membrane, without reducing the waterproofness and breathability characteristics of the sole.

10       Moreover, the manufacture of the sole does not entail particular constructive complications with respect to conventional soles.

The invention thus conceived is susceptible of numerous modifications and variations, all of which are within the scope of the appended claims.

15       All the details may further be replaced with other technically equivalent elements.

In practice, the dimensions may be any according to requirements.

The disclosures in Italian Patent Application No. PD2002A000187 from which this application claims priority are incorporated herein by reference.

CLAIMS

1. A waterproof and breathable sole for shoes, having a structure that comprises:

-- a mid-sole component (10, 110) with a membrane (11, 111) made of a material that is impermeable to water and permeable to water vapor and is connected in spots with a lower protective layer (14, 114) made of a material that is resistant to hydrolysis, water-repellent, breathable and/or perforated;

-- a tread (15, 115) made of perforated elastomer that is joined perimetrically and hermetically to the component (10, 110);

said structure being characterized in that said membrane (11, 111) is associated with said protective layer (14, 114) by way of a thermoreactive adhesive (13, 113).

2. The sole having the structure according to claim 1, characterized in that said membrane (11) and said protective layer (14) associated therewith are joined hermetically to said tread (15), which is overmolded or assembled in place on said component (10).

3. The sole having the structure according to claim 1, characterized in that said membrane (111) and said protective layer (114) are part of a mid-sole (110) with a preassembled insert that comprises a perimetric element (117) that is overmolded or assembled in place and surrounds said membrane (111) and said protective layer (114) and is joined to them hermetically, said insert (110) being coupled to said tread (115), which is overmolded or assembled in place thereon.

4. The sole according to one or more of the preceding claims, characterized in that said thermoreactive adhesive is a thermoplastic polyurethane adhesive.

5. Use of thermoreactive adhesives to join in spots a membrane (11, 111) made of a material that is impermeable to water and permeable to water vapor and a protective layer (14, 114) made of a material that is

resistant to hydrolysis, water-repellent, breathable and/or perforated, in order to provide waterproof and breathable soles for shoes.

6. The use according to claim 5, characterized in that said thermoreactive adhesive is a thermoplastic polyurethane adhesive.

- 5        7.A method for making a waterproof and breathable sole for shoes that has a structure having a mid-sole component (10, 110) with a membrane (11, 111) made of a material that is impermeable to water and permeable to water vapor and is connected in spots with a lower protective layer (14, 114) made of a material that is resistant to hydrolysis, water-repellent,  
10        breathable and/or perforated; a tread (15, 115) made of perforated elastomer that is joined perimetricaly and hermetically to the component (10, 110); comprising a step of connecting said membrane (11, 111) to said protective layer (14, 114) by way of a thermoreactive adhesive (13, 113).

## INTERNATIONAL SEARCH REPORT

International Application No

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## A. CLASSIFICATION OF SUBJECT MATTER

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According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 A43B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 02 32246 A (POLEGATO MORETTI MARIO ;NOTTINGTON HOLDING BV (NL)) 25 April 2002 (2002-04-25) cited in the application the whole document	1-7
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Y	WO 98 51177 A (POLEGATO MARIO ;NOTTINGTON HOLDING BV (NL)) 19 November 1998 (1998-11-19) cited in the application the whole document	1-7
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Further documents are listed in the continuation of box C.



Patent family members are listed in annex.

## \* Special categories of cited documents:

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Date of the actual completion of the international search

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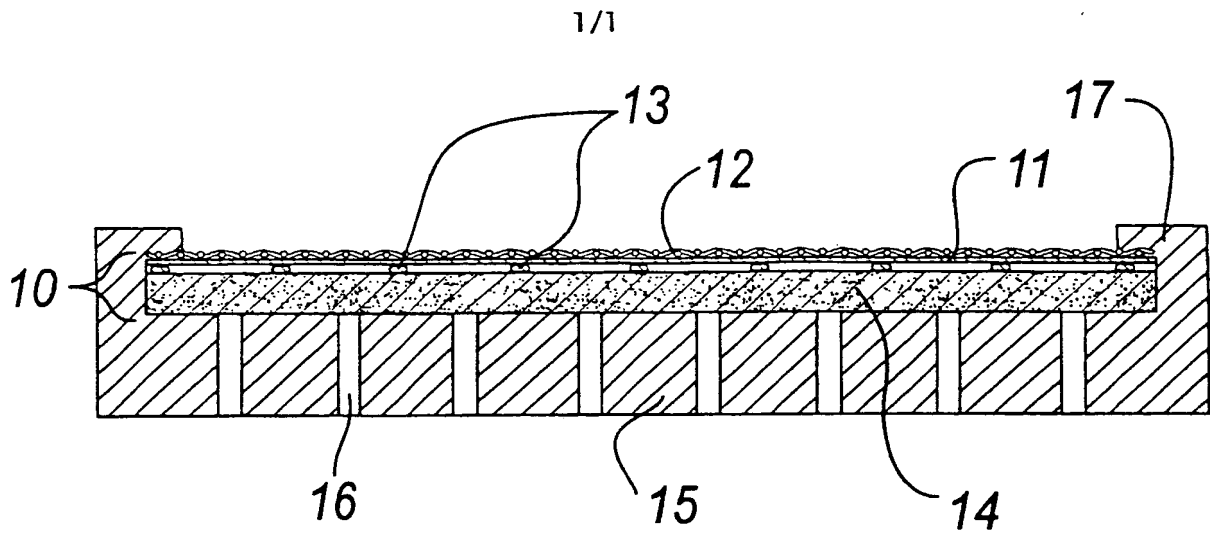
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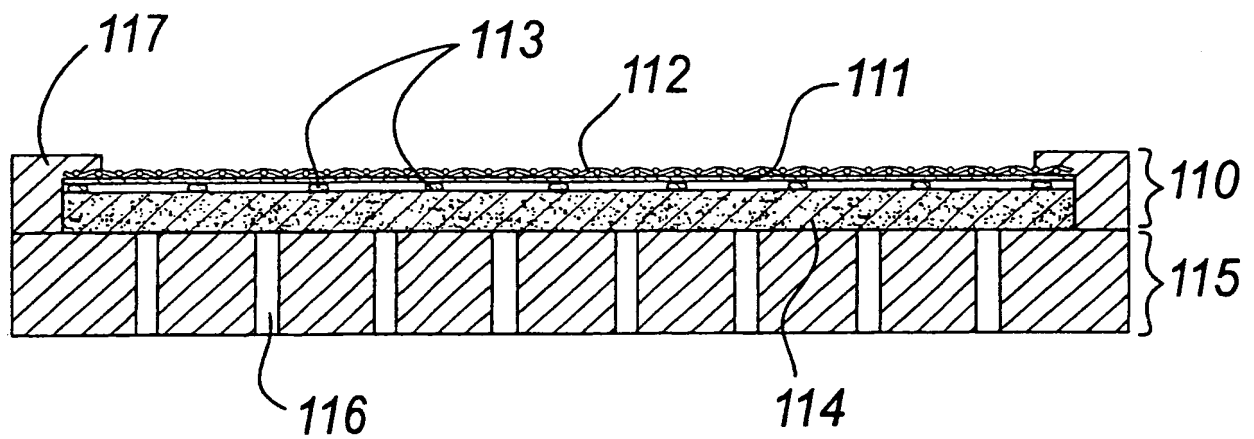
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Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,  
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Authorized officer

Cianci, S



*Fig. 1*



*Fig. 2*

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## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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Form PCT/ISA/210 (continuation of second sheet) (July 1992)

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II Information on patent family members

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(74) Agent: **MODIANO, Guido**; Modiano & Associati, Via Meravigli, 16, I-20123 Milano (IT).

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CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

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